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1	POWER TOOL WITH AT LAST ONE HANDLE
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3	Related Art
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5	The invention is based on a power tool with at least one handle according to the
6	preamble of Claim 1.
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8	A handle for guiding or holding vibrating devices was made known in DE 87 01
9	722.9 C1. The handle comprises a grip part having a metal core coated with a
10	vibration-damping plastic. A first piece of sheet metal is connected to the metal
11	core on one end via a screw, which first piece of sheet metal is connected to a
12	second piece of sheet metal via an elastic buffer in the axial direction opposite to
13	the grip part. The second piece of sheet metal, in turn, is connected to a guide
14	shaft of the device via a screw.
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16	Advantages of the Invention
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18	The invention is based on a power tool with at least one handle that comprises at
19	least one grip part that is firmly connected to a mounting part via at least one
20	elastic, vibration-damping element, via which the grip part is affixable to a
21	housing.
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23	It is proposed that a connection between the grip part and the mounting part is
24	secured using the elastic element via at least one movable retaining element. If
25	the elastic element becomes damaged, the grip part can be prevented from
26	separating from the housing, and control of the power tool via the grip part can
27	be ensured at all times. Transmission of vibrations via the retaining element can
28	be prevented by means of the movable design of the retaining element when [the
29	power tool is] operated properly. The mounting part is advantageously designed
30	as a piece separate from the housing, although it can also be designed at least
31	partially integrated with the housing of the power tool.

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In a further embodiment, however, it is proposed that the retaining element is 1 2 formed by a flexible element, e.g., by a chain or, advantageously, by a plastic or 3 wire rope, etc. When a flexible retaining element is used, a transmission of 4 vibrations can be prevented cost-effectively using a simple design, and the 5 retaining element can be favorably integrated in the elastic element. 6 7 In order to protect the retaining element from damage during operation of the 8 power tool, and to make a concealed integration of the retaining element in the 9 handle possible, the elastic element advantageously encloses the retaining 10 element. 11 12 It is further proposed that the retaining element is located in the elastic element in 13 the center along a centerline, by way of which, when a tilting motion takes place, 14 undesired tensile stresses in the retaining element and a transmission of 15 vibration associated therewith can be prevented. 16 17 If the retaining element, in the installed state, is subjected to compressive 18 stresses, and the elastic element is subjected to tensile stresses, a higher 19 loadability of the elastic element can be achieved than without pretension, and 20 breakage or separation from the grip part and from the mounting part and/or a 21 tearing of the elastic element can be prevented. Moreover, the retaining element 22 can be used advantageously to secure the elastic element to the grip part and to 23 the mounting part, e.g., in that the retaining element applies a contact force 24 necessary for a cemented joint. The compressive stress can be advantageously 25 achieved in the elastic element by tensioning the retaining element, e.g., by 26 tensioning a flexible retaining element—advantageously located in the middle of 27 the elastic element along a centerline—using a fastening screw. 28 29 In a further embodiment according to the invention, it is proposed that the 30 retaining element is formed by a band that encloses the elastic element. The 31 retaining element designed in the shape of a band can protect the elastic

1 element—formed out of a usually soft material—against outside influences and 2 damage during operation, e.g., against heat, effects of ultraviolet radiation, dust, 3 moisture, and hard objects, etc., by means of its closed surface. The band can 4 be produced out of various materials appearing reasonable to one skilled in the 5 art, e.g., out of fabric tape, etc. Basically, the retaining element can also be 6 formed cost-effectively out of at least one flexible component that is located 7 radially outside of the elastic element, e.g., out of one or more ropes. 8 9 In order to protect the elastic element from outside influences, it can also be 10 enclosed in a sleeve made of solid material, which sleeve can be secured to the 11 grip part or the mounting part and is located at a distance from the grip part or 12 the mounting part in order to prevent transmission of vibrations. 13 14 The retaining element can be formed out of a rigid component instead of a 15 flexible component, which rigid component is supported in movable fashion 16 relative to the mounting part and/or the grip part. The retaining element can be 17 designed to be easily installed or removed, so it can be replaced if damaged. 18 Moreover, a maximum displacement of the elastic element from a normal 19 position can be easily determined in at least one tilting direction and/or one 20 sliding direction via the retaining element and, in particular, via a rigid retaining 21 element. An overstretching of the elastic element can be prevented by means of 22 the retaining element, and a long service life can be achieved. 23 24 The retaining element is advantageously supported firmly in the mounting part 25 and in movable fashion relative to the grip part, whereby a space in the grip part 26 can advantageously be used for a freedom of motion of the retaining element 27 and a simple installation starting with the grip part can be achieved. Moreover, a 28 fastening screw located in the mounting part can be used for a firm connection of 29 the retaining element. Additional mounting parts for the retaining element can be 30 spared. Basically, however, the retaining element can also be designed to be 31 rigid in the grip part and movable in relation to the mounting part.

1 It is further proposed that the retaining element is formed by a screw that can be 2 screwed particularly advantageously into the fastening screw in the mounting part. A screw is particularly cost-effective and can be installed and removed 3 4 particularly easily and quickly. Instead of a screw, however, a bolt could be used that can be secured either in the grip part or in the mounting part in positive, non-5 positive, and/or bonded fashion, e.g., it can be pressed in the fastening screw in 6 7 the mounting part. 8 9 In addition to a rigid bar, a screw, a chain, and a rope, furthermore, a spring can be used as the retaining element, in particular a coiled spring. Using a fastening 10 11 element formed by a coiled spring, a particularly simple installation can be 12 achieved, particularly in automated series production. 13 In order to make an advantageous uniform cooling, and advantageously 14 15 homogenous microstructure, and an advantageously bonded connection to the 16 mounting part and/or the grip part possible after injection molding of the elastic 17 element, the elastic element comprises a non-circular cross-sectional area at 18 least closely before an advantageously round seating surface with the mounting 19 element and/or with the grip part that is smaller than the seating surface, and, in fact, the cross-sectional area is composed particularly advantageously of a round 20 21 core area and arched extensions abutting the core area radially on the outside. 22 Using a round contour, an advantageously large seating surface between the 23 elastic element and the mounting part and the grip part can be achieved. The 24 seating region can be cooled advantageously by means of the smaller cross-25 sectional area abutting this. 26 27 Moreover, an advantageous microstructure can be enhanced by dissipating heat 28 from an internal region of the elastic element via at least one component during 29 production of the elastic element. The component can be formed by means of a 30 retaining element inserted in the elastic element during production itself, or 31 advantageously by a core that is removed after the elastic element is

1	manufactured, and advantageously forms a recess for the retaining element.					
2	Advantageously, the core can be cooled compared to the inserted retaining					
3	element using a coolant by means of a cooling passage. When using retaining					
4	elements in particular that are formed out of rigid components and that can be					
5	installed easily after production of the elastic element, it is advantageous that the					
6	elastic element can be cooled by means of a core during production.					
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8	The means of attaining the object of the invention can be used with various					
9	power tools appearing practical to one skilled in the art, e.g., with hammer drills,					
10	rotary hammers, drills, power-operated screw drivers, sawing, milling, planing,					
11	etc. The means of attaining the object of the invention according to the invention					
12	can be used with particular advantage in angle grinders, however, and, in fact,					
13	using an additional handle extending transversely to the longitudinal direction,					
14	which serves primarily to guide the angle grinder.					
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17		Brief Description of the Drawing				
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19	Further adva	ntages arise from the following drawing description. Exemplary				
20	embodiments of the invention are presented in the drawing. The drawing, the					
21	description, and the claims contain numerous features in combination. One					
22	skilled in the art will advantageously consider them individually as well and					
23	combine them into reasonable further combinations.					
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25	Figure 1	shows a schematic representation of an angle grinder from above,				
26	Figure 2	shows a handle according to the invention comprising a flexible				
27		retaining element enclosed in an elastic element,				
28	Figure 3	shows a handle with a retaining element designed in the shape of a				
29		rod,				
30	Figure 4	shows a section of an alternative to Figure 3,				
31	Figure 5	shows a view along the line V-V in Figure 4 during assembly				

1	Figure 6 shows a handle comprising an elastic element enclosed by a				
2		retaining element designed in the shape of a band,			
3	Figure 7	shows a variant of Figure 3,			
4	Figure 8	shows a view along the line VIII-VIII in Figure 7,			
5	Figure 9	shows a view along the line IX-IX in Figure 7,			
6	Figure 10	shows a view along the line X-X in Figure 7,			
7	Figure 11	shows a view along the line XI-XI in Figure 7, and			
8	Figure 12	shows a handle according to Figure 7 during its production.			
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11		Detailed Description of the Exemplary Embodiment			
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13	Figure 1 shows an angle grinder having an electric motor (not shown) supported				
14	in a housing 56, via which a cutoff wheel clamped in the toolholder is driveable.				
15	The angle grinder is guidable via a first handle 58 integrated in the housing 56 on				
16	the side opposite to the cutoff wheel 54 and extending in the longitudinal				
17	direction, and via a second handle 10 secured to a gearbox housing 60 in the				
18	region of the cutoff wheel 54 or the toolholder and extending transversely to the				
19	longitudinal direction. The handle 10 comprises a grip part 12 that is firmly				
20	connected via an elastic, vibration-damping plastic element 14 to a mounting part				
21	16, via which the grip part 12 is secured to the gearbox housing 60 of the angle				
22	grinder via a set screw 18 integrally molded to the mounting part 16. The elastic				
23	plastic element 14 is integrally extruded on the grip part 12 and the mounting part				
24	16 and, as	a result, is firmly connected to them.			
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26	According to	o the invention, the grip part 12, in addition to the elastic plastic			
27	element 14, is connected to the mounting part 16 via a movable retaining				
28	element 20 (Figure 2). The retaining element 20 is formed by a flexible				
29	component in the form of a wire rope and is located in the elastic plastic element				
30	14 along a centerline. Threaded sleeves (not shown) are secured to the ends of				
31	the retaining element 20, via which the retaining element 20 is screwed to the				

1 grip part 12 and the mounting part 16. The elastic plastic element 14 encloses 2 the retaining element 20. The retaining element 20, in the installed state, is 3 subjected to tensile stresses, and the elastic element 14 is subjected to 4 compressive stresses. 5 6 Figure 3 shows a further embodiment of a handle 26 according to the invention. 7 in which a retaining element 22 is formed by a rigid rod supported in movable fashion and enclosed in an elastic plastic element 24 applied by injection 8 9 molding, to the ends of which washers 30, 32 are secured in each case. 10 Components that are essentially identical are labelled with the same reference 11 numerals in the exemplary embodiments presented. With regard for features and 12 functions that remain the same, reference is made to the description of Figure 1. 13 One sleeve 34, 36 each is secured to the mounting part 16 and the grip part 12. 14 15 each of which comprises a washer 38, 40 having coaxial openings 42, 44 in the 16 direction toward the elastic plastic element 24. The sleeves 34, 36 and the 17 washers 38, 40 each abut a space 46, 48 filled via injection with an elastic 18 material, into which the retaining element 22 with its washers 30, 32 is inserted. 19 The washers 30, 32 of the retaining element 22 have a larger diameter than the 20 openings 42, 44 and are held captive in the spaces 46, 48. 21 22 For installation, the washer 30 can be unscrewed from the rod-shaped part of the 23 retaining element 22. The retaining element 22 can then be inserted into 24 this—before installation of the sleeves 34, 36 with the grip part 12 or the 25 mounting part 16—and the washer 30 can be screwed to the rod-shaped part 26 once more. The sleeves 34, 36 are connected to the grip part 12 or the mounting 27 part 16 via threaded joints (not shown). After the sleeves 34, 36 are connected to 28 the grip part 12 and the mounting part 16, the retaining element 22 is coated with 29 elastic plastic applied by injection molding.

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The sleeves 34, 36, with their washers 38, 40, advantageously produce a 1 2 positive connection between the grip part 12 and the elastic plastic element 24, 3 and between the elastic plastic element 24 and the mounting part 16. Basically, however, the elastic plastic element could be designed with the retaining 4 5 element, the sleeves, and the washers as an assembly capable of being preassembled, which is then screwed and cemented to the grip part and the 6 7 mounting part. 8 9 A maximum displacement of the elastic plastic element 24 is determined by a 10 freedom of motion of the washers 30, 32 of the retaining element 22 in the 11 spaces 46, 48, in all directions, in fact. In order to prevent a transmission of 12 vibrations via the retaining element 22, the retaining element 22 is situated at a 13 distance—filled with an elastic material—from the sleeves 34, 36 and the 14 washers 38, 40 when [the power tool] is operated properly. 15 16 A further exemplary embodiment of a handle 62 is shown in Figures 4 and 5, in which a retaining element 64 is formed by a rigid rod supported in movable 17 18 fashion and comprising a coating of an elastic plastic element 24 applied by injection molding, the ends 66, 68 of which are designed in the shapes of 19 washers. With regard for features and functions that remain the same, reference 20 21 is made to the description of Figure 3. 22 23 One structural part 74, 76 each is integrally molded to a mounting part 70 and a grip part 72, each of which is designed in the shape of a washer in the direction 24 25 toward the elastic plastic element 24 and which comprise coaxial openings 78, 26 80. 27 28 The structural parts 74, 76 each abut a space 82, 84 filled with an elastic material 29 applied by injection, into which the retaining element 64—designed as a single 30 piece—is inserted with its washer-shaped ends 66, 68 during assembly. The 31 retaining element 64 with its rod-shaped part is thereby guided transverse to the

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longitudinal direction of the handle 62 through lateral openings 86, 88 in the 1 2 structural parts 74, 76 (Figure 5). The retaining element 64 is then secured in the 3 structural parts 74, 76 against the direction of its insertion 90 by means of the openings 86, 88 by pushing structural parts 92, 94—each of which has an L-4 5 shape in the longitudinal view—perpendicular to the direction of insertion 90 and 6 transverse to the longitudinal direction with one opening 96, 98 each over the 7 rod-shaped part of the retaining element 64. The rod-shaped ends 66, 68 of the retaining element 64 have a greater diameter than the openings 78, 80 and are 8 9 held captive in the spaces 82, 84. The retaining element 64 is then coated with 10 plastic applied by injection molding. 11 12 A width 100 of the openings 86, 88 transverse to the longitudinal direction of the 13 handle 62 and perpendicular to the direction of insertion 90 of the retaining 14 element 64 is advantageously designed smaller than a diameter 102 of the rod-15 shaped part of the retaining element 64, so that the retaining element 64 must be pushed through the openings 86, 88 against resistance and then locks in place in 16 17 the openings 78, 80 of the structural parts 74, 76. The retaining element 64 is secured in the openings 78, 80 of the structural parts 74, 76, and the structural 18 19 parts 92. 94 can be advantageously spared. 20 21 Figure 6 shows a further exemplary embodiment of a handle 50 in which, 22 according to the invention, a retaining element 28 is formed by a flexible fabric 23 tape that encloses an elastic plastic element 52. The band-shaped retaining 24 element 28 is designed to be essentially non-elastic in the longitudinal direction 25 of the handle 50 and comprises a plastic flange (not shown) abutting the grip part 26 12 and abutting the mounting part 16 in each case, with which the band-shaped 27 retaining element 28 is firmly connected to the grip part 12 or with the mounting 28 part 16 via arresting connections. 29 30 In order to prevent a transmission of vibrations via the retaining element 28, it is 31 designed longer than the elastic plastic element 52. The elastic plastic element

52 is protected by the retention element 28 against outside influences and damage while the angle grinder is in use. Moreover, a maximum displacement of the elastic plastic element 52 from its normal position is determined by the retention element 28 and, in fact, in the directions of push, tilt, and pull. In the maximum displacement positions, the retention element 28 is tensioned and prevents a further displacement of the elastic plastic element 52.

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A handle 104 that is an alternative to the exemplary embodiment in Figure 3 is shown in Figures 7 through 12. The handle 104 comprises a mounting part 110 that is firmly connected via an elastic plastic element 108 with a grip part 106. The connection between the mounting part 110 and the grip part 106 is secured via a retention element 112 formed by a screw (Figure 8).

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During production of the handle 104, the mounting part 110 and the grip part 106 are first produced out of plastic via injection molding, and a fastening screw 114 is inserted in the mounting part 110 and coated via injection molding with positive engagement in the axial direction and in the direction of rotation, which fastening screw 114 comprises an external thread 118 as well as an internal thread 120 for fastening to a machine housing in the direction of the grip part 106. The fastening screw 114 could also be pressed into a mounting part afterwards. After applying a coating to the fastening screw 114 via injection molding, the mounting part 110 with the fastening screw 114 and the grip part 106 are placed in a casting mold 140 in order to become bonded to the elastic plastic element 108 in an injection molding procedure (Figure 12). The casting mold 140 is shaped so that the elastic plastic element 108 comprises a non-circular cross-sectional area 116 closely before a round seating surface 146 with the mounting part 110 and a round seating surface 134 with the grip part 106, each of which is smaller than the seating surfaces 134, 146 and, in fact, the cross-sectional areas 116 each comprises a round core area 122 abutted radially on the outside by four arched extensions 124, 126, 128, 130 (Figures 9 and 11). More or fewer than four arched extensions 124, 126, 128, 130 would also be possible. The elastic plastic

1 element 108 comprises a round cross-sectional area 136 in a center region 2 (Figure 10). 3 4 Moreover, a core 142 cooled via a fluid passage 148 is placed in the casting 5 mold 140 that forms a recess 144 for the retention element 112, via which core 6 142 heat is dissipated from the interior region of the elastic plastic element 108 7 during production. The grip part 106 is designed hollow inside and comprises a 8 recess 138 in the direction of the mounting part 110 through which the core 142 9 extends, and which is partially filled with the elastic plastic element 108 applied 10 via injection, so that a flange 150 of the elastic plastic element 108 grips behind 11 an edge region of the recess 138. 12 13 Once the elastic plastic element 108 has cooled and the core 142 has been 14 removed, the retention element 112 of the grip part 106 is guided through the 15 recess 144 formed by the core 142 in the direction of the mounting part 110 16 through the elastic plastic element 108 and is screwed into the interior thread 120 17 in the fastening screw 114. The retention element 112 comprises a screw head 18 132 that, when the retention element 112 is installed, is situated at a distance 19 from the grip part 106, so that the retention element 112 is supported in movable 20 fashion relative to the grip part 106. The screw head 132 is larger than the 21 recesses 138 and 144, so that, if the elastic plastic element 108 becomes 22 damaged, the grip part 106 is connected to the mounted part 110 in captive 23 fashion. The distance between the screw head 132 and the grip part 106 24 determines a maximum permissible displacement of the elastic plastic element 25 108. Direct contact between the screw head 132 and the grip part 106 is 26 prevented and transmission of vibrations is largely prevented by means of the 27 flange 150 when maximum displacement occurs. 28 29 30

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1		Reference Numerals				
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	10	Handle	52	Element		
	12	Grip part	54	Cutoff wheel		
	14	Element	56	Housing		
	16	Mounting part	58	Handle		
	18	Set screw	60	Gearbox housing		
	20	Retaining element	62	Handle		
	22	Retaining element	64	Retaining element		
	24	Element	66	End		
	26	Handle	68	End		
	28	Retaining element	70	Mounting part		
	30	Washer	72	Grip part		
	32	Washer	74	Structural part		
	34	Sleeve	76	Structural part		
	36	Sleeve	78	Opening		
	38	Washer	80	Opening		
	40	Washer	82	Space		
	42	Opening	84	Space		
	44	Opening	86	Opening		
	46	Space	88	Opening		
	48	Space	90	Direction of insertion		
	50	Handle	92	Structural part		

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94 Structural part Opening 96 98 Opening 100 Width 102 Diameter 104 Handle 106 Grip part 108 Element 110 Mounting part 112 Retaining element 114 Fastening screw 116 Cross-sectional area 118 External thread 120 Internal thread 122 Core area 124 Extension 126 Extension 128 Extension 130 Extension 132 Screw head 134 Seating surface 136 Cross-sectional area 138 Recess 140 Casting mold 142 Component 144 Recess 146 Seating surface 148 Fluid passage

150 Flange